

CLAIMS:

- 1) A method of assembling an object using a component, the component having an interface surface having coded data disposed thereon or therein, each coded data portion being indicative of an identity of the component, wherein the method includes, in a sensing device:
 - 5 (a) sensing coded data on the component;
 - (b) generating, using the sensed coded data, indicating data indicative of the identity of the component; and,
 - (c) transferring the indicating data to at least one of:
 - 10 (i) an assembly system which is responsive to the indication to assemble the object; and,
 - (ii) a computer system which is responsive to the indication to cause an assembly system to assemble the object.
- 2) The method of claim 1, wherein the method includes, in the assembly system:
 - 15 (a) receiving the indicating data;
 - (b) generating, from the received indicating data, component identity data indicative of the identity of the component; and,
 - (c) assembling the object using the component identity data.
- 3) The method of claim 1, wherein the coded data portions are provided at respective positions on the interface surface, and wherein the method includes, in the sensing device:
 - 20 (a) generating, using the sensed coded data portion, indicating data indicative of the component identity and at least one of:
 - (i) a position of the sensed coded data portion;
 - (ii) a position of the sensing device relative to the interface surface;
 - 25 (iii) an orientation of the sensed coded data; and,
 - (iv) an orientation of the sensing device relative to the interface surface; and,
 - (b) transferring the indicating data to the assembly system, the assembly system being responsive to the indicating data to determine the orientation of the component.
- 4) The method of claim 3, wherein the method includes, in the assembly system:
 - 30 (a) receiving the indicating data;
 - (b) generating, using the received indicating data:
 - (i) component identity data indicative of the identity of the component;
 - (ii) position data indicative of at least one of:
 - 35 (1) the position of the sensed coded data portion;
 - (2) the position of the sensing device relative to the interface surface;
 - (3) the orientation of the sensed coded data; and,

- (4) the orientation of the sensing device relative to the interface surface; and,
 - (c) generating, using the component identity data and the position data, orientation data indicative of the orientation of the component; and,
 - (d) assembling the object using the orientation data.
- 5 5) The method of claim 1, wherein the interface surface includes at least one region having at least one coded data portion provided therein, the at least one coded data portion being indicative of an identity of the region, and wherein the method includes, in a sensing device:
 - (a) sensing at least one coded data portion;
 - 10 (b) generating, using the sensed coded data portion, indicating data indicative of the region identity; and,
 - (c) transferring the indicating data to the assembly system, the assembly system being responsive to the indicating data to determine the orientation of the component.
- 6) The method of claim 5, wherein the method includes, in the assembly system:
 - (a) receiving the indicating data;
 - 15 (b) generating, using the received indicating data, region identity data indicative of the identity of the region;
 - (c) generating, using the region identity data, orientation data indicative of the orientation of the component; and,
 - (d) assembling the object using the orientation data.
- 20 7) The method of claim 1, wherein the component has a plurality of faces, each face having at least one coded data portion provided at a respective position thereon, and wherein the method includes, in the sensing device:
 - (a) generating, using the sensed coded data portion, indicating data indicative of the component identity and at least one of:
 - 25 (i) a position of the sensed coded data portion;
 - (ii) a position of the sensing device relative to the face;
 - (iii) an orientation of the sensed coded data; and,
 - (iv) an orientation of the sensing device relative to the face; and,
 - (b) transferring the indicating data to the assembly system, the assembly system being responsive to the indicating data to identify a face.
- 30 8) The method of claim 1, wherein the method includes, in the assembly system:
 - (a) receiving the indicating data;
 - (b) generating, using the received indicating data:
 - (i) component identity data indicative of the identity of the component;
 - 35 (ii) position data indicative of at least one of:
 - (1) the position of the sensed coded data portion;

- (2) the position of the sensing device relative to the face;
- (3) the orientation of the sensed coded data; and,
- (4) the orientation of the sensing device relative to the face; and,
- (c) identifying, using the component identity data and the position data, the face; and,
- 5 (d) assembling the object using the determined face.
- 9) The method of claim 1, wherein the component has a plurality of faces, each face having at least one region including at least one coded data portion therein, the at least one coded data portion being indicative of an identity of the at least one region, and wherein the method includes, in the sensing device:
- 10 (a) generating, using the sensed coded data portion, indicating data indicative of the region identity; and,
- (b) transferring the indicating data to the assembly system, the assembly system being responsive to the indicating data to determine the face.
- 10) The method of claim 9, wherein the method includes, in the assembly system:
- 15 (a) receiving the indicating data;
- (b) generating, using the received indicating data, region identity data indicative of the identity of the region;
- (c) identifying, using the region identity data, the face; and,
- (d) assembling the object using the determined face.
- 20 11) The method of any one of claim 8 and claim 10, wherein the method includes, in the computer system:
- (a) determining the orientation of the component using the face; and,
- (b) assembling the object using the determined orientation.
- 12) The method of claim 1, wherein the component is formed from a first component adapted to be
- 25 coupled to a second component, the second component having second coded data disposed thereon or therein, wherein the second coded data includes a plurality of second coded data portions, each second coded data portion being indicative of an identity of the component and the position of the second coded data portion on the interface surface, wherein the method includes, in the sensing device:
- 30 (a) sensing at least one second coded data portion;
- (b) generating, using the sensed second coded data portion, second indicating data indicative of the second component identity; and,
- (c) transferring the second indicating data to the assembly system, the assembly system being responsive to the second indicating data to couple the first component to the second
- 35 component.

- 13) A method of assembling an object using a component, the component having an interface surface having coded data disposed thereon or therein, each coded data portion being indicative of an identity of the component, wherein the method includes, in an assembly system:
- (a) receiving indicating data from a sensing device, the sensing device being responsive to sensing of the coded data to generate indicating data indicative of the identity of the component;
 - (b) generating, using the received indicating data, component identity data indicative of the identity of the component; and,
 - (c) assembling the object using the component identity data.
- 14) The method of claim 13, wherein the coded data portions are provided at respective positions on the interface surface, and wherein the method includes, in the computer system:
- (a) receiving indicating data from a sensing device, the sensing device being responsive to sensing of the coded data to generate indicating data indicative of the identity of the component and at least one of:
 - (i) a position of the sensed coded data portion;
 - (ii) a position of the sensing device relative to the interface surface;
 - (iii) an orientation of the sensed coded data; and,
 - (iv) an orientation of the sensing device relative to the interface surface; and,
 - (b) generating, using the received indicating data:
 - (i) component identity data indicative of the identity of the component;
 - (ii) position data indicative of at least one of:
 - (1) the position of the sensed coded data portion;
 - (2) the position of the sensing device relative to the interface surface;
 - (3) the orientation of the sensed coded data; and,
 - (4) the orientation of the sensing device relative to the interface surface; and,
 - (c) generating, using the component identity data and the position data, orientation data indicative of the orientation of the component; and,
 - (d) assembling the object using the orientation data.
- 15) The method of claim 13, wherein the interface surface includes at least one region having at least one coded data portion provided therein, the at least one coded data portion being indicative of an identity of the region, and wherein the method includes, in the assembly system:
- (a) receiving indicating data from a sensing device, the sensing device being responsive to sensing of the coded data to generate indicating data indicative of the region identity;
 - (b) generating, using the received indicating data, region identity data indicative of the identity of the region;

(c) generating, using the region identity data, orientation data indicative of the orientation of the component; and,

(d) assembling the object using the orientation data.

16) The method of claim 13, wherein the component has a plurality of faces, each face having at least one coded data portion provided at a respective position thereon, and wherein the method includes, in the assembly system:

(a) receiving indicating data from a sensing device, the sensing device being responsive to sensing of the coded data to generate indicating data indicative of the identity of the component and at least one of:

- (i) a position of the sensed coded data portion;
- (ii) a position of the sensing device relative to the face;
- (iii) an orientation of the sensed coded data; and,
- (iv) an orientation of the sensing device relative to the face; and,

(b) generating, using the received indicating data, at least one of:

- (i) component identity data indicative of the identity of the component;
- (ii) position data indicative of at least one of:
- (iii) the position of the sensed coded data portion;
- (iv) the position of the sensing device relative to the face;
- (v) the orientation of the sensed coded data; and,
- (vi) the orientation of the sensing device relative to the face; and,

(c) identifying, using the component identity data and the position data, the face; and,

(d) assembling the object using the determined face.

17) The method of claim 13, wherein the component has a plurality of faces, each face having at least one region including at least one coded data portion therein, the at least one coded data portion being indicative of an identity of the at least one region, and wherein the method includes, in the assembly system:

(a) receiving indicating data from a sensing device, the sensing device being responsive to sensing of the coded data to generate indicating data indicative of the identity of the region identity;

(b) generating, using the received indicating data, region identity data indicative of the identity of the region;

(c) identifying, using the region identity data, the face; and,

(d) assembling the object using the determined face.

18) The method of any one of claim 15 and claim 17, wherein the method includes, in the assembly system:

(a) determining the orientation of the component using the face; and,

(b) assembling the object using the determined orientation.

19) The method of claim 13, wherein the component is a first component adapted to be coupled to a second component, the second component having second coded data disposed thereon or therein, wherein the second coded data includes a plurality of second coded data portions, each second coded data portion being indicative of an identity of the second component, wherein the method includes, in the assembly system:

(a) receiving second indicating data from a sensing device, the sensing device being responsive to sensing of the second coded data to generate second indicating data indicative of the second component identity;

(b) generating, using the received second indicating data, second component identity data indicative of the identity of the second component; and,

(c) assembling the first component in the second component using the second component identity data.

20) A method of assembling an object, the component having an interface surface having coded data disposed thereon or therein, wherein the coded data includes a plurality of coded data portions, each coded data portion being indicative of an identity of the component, wherein the method includes:

(a) in a sensing device:

(i) sensing at least one coded data portion;

(ii) generating, using the sensed coded data portion, indicating data indicative of the identity of the component; and,

(iii) transferring the indicating data to an assembly system; and,

(b) in the assembly system;

(i) receiving the indicating data;

(ii) generating, using the received indicating data component identity data indicative of the identity of the component; and,

(iii) assembling the object using the component identity data.

21) A method of assembling an object, the component having an interface surface having coded data disposed thereon or therein, wherein the coded data includes a plurality of coded data portions, each coded data portion being indicative of an identity of the component, wherein the method includes:

(a) in a sensing device:

(i) sensing at least one coded data portion;

(ii) generating, using the sensed coded data portion, indicating data indicative of the identity of the component; and,

(iii) transferring the indicating data to a computer system; and,

(b) in the computer system;

(i) receiving the indicating data;

(ii) generating, using the received indicating data, component identity data indicative of the identity of the component; and,

5 (iii) causing, using the component identity data, an assembly system to assemble the object.

22) A method of assembling an object using a component, the component having an interface surface having coded data disposed thereon or therein, each coded data portion being indicative of an identity of the component, wherein the method includes, in a computer system:

10 (a) receiving indicating data from a sensing device, the sensing device being responsive to sensing of the coded data to generate indicating data indicative of the identity of the component;

(b) generating, using the received indicating data, component identity data indicative of the identity of the component; and,

15 (c) causing, using the component identity data, an assembly system to assemble the object.

23) The method of any one of claims 1, 13 20, 21 and 22, wherein the assembly system including a computer system, wherein the method includes, in the computer system:

(a) determining, from the component identity data, assembly procedures; and,

20 (b) controlling one or more manipulators in accordance with the assembly procedures to thereby assemble the object.

24) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is indicative of an EPC associated with the component.

25) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data distinguishes the component from every other component.

25 26) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is redundantly encoded.

27) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is redundantly encoded using Reed-Solomon encoding.

30 28) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is substantially invisible to the unaided eye.

29) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is printed using infrared ink.

30) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is provided on the interface surface coincident with visible markings representing at least one of:

35 (a) component information;

(b) orientation information;

- (c) the identity of the component; and,
- (d) component status information.

31) The method of any one of claims 1, 13 20, 21 and 22, wherein the interface surface is at least a portion of at least one of:

- 5 (a) component packaging;
- (b) component labelling; and,
- (c) a surface of the component.

32) The method of any one of claims 1, 13 20, 21 and 22, wherein the coded data is disposed over at least one of:

- 10 (a) substantially all of any one of:
 - (i) an entire component surface;
 - (ii) packaging; and,
 - (iii) a component label;
- (b) more than 25% of any one of:
 - 15 (i) an entire component surface;
 - (ii) packaging; and,
 - (iii) a component label;
- (c) more than 50% of any one of:
 - (i) an entire component surface;
 - 20 (ii) packaging; and,
 - (iii) a component label;
- (d) more than 75% of any one of:
 - (i) an entire component surface;
 - (ii) packaging; and,
 - 25 (iii) a component label.

33) The method of any one of claims 1, 13, 20, 21 and 22, wherein the assembly system includes a computer system.

34) The method of any one of claims 1, 13, 20, 21 and 22, wherein the assembly system communicates with a remote computer system.

30 35) A system for assembling an object using a component, the component having an interface surface having coded data disposed thereon or therein, wherein the coded data includes a plurality of coded data portions, each coded data portion being indicative of an identity of the component, wherein the system includes a sensing device which:

- (a) senses at least one coded data portion;
- 35 (b) generates, using the sensed coded data portion, indicating data indicative of the identity of the component; and,

(c) transfers the indicating data to at least one of:

(i) an assembly system which is responsive to the indication to assemble the object;
and,

(ii) a computer system which is responsive to the indication to cause an assembly
system to assemble the object.

(d)

36) The system of claim 35, wherein the sensing device includes:

(a) a sensor for sensing the at least one exposed coded data portion; and

(b) a processor for generating, using at least some of the sensed coded data, indicating data
indicative of the identity of the component.

37) The system of claim 37, wherein the sensing device includes a laser for emitting at least one
scanning beam, the scanning beam being directed in first and second orthogonal directions to
thereby generate a raster scan pattern over a scanning patch, the scanning patch being provided
in the sensing region such that it exposes at least one coded data portion.

38) The system of claim 35, wherein the sensing device is adapted to perform the method of claim
1.

39) A system for assembling an object using a component, the component having an interface
surface having coded data disposed thereon or therein, wherein the coded data includes a
plurality of coded data portions, each coded data portion being indicative of an identity of the
component and the position of the coded data portion on the interface surface, wherein the
system includes an assembly system which:

(a) receives, from a sensing device, indicating data generated in response to sensing of a coded
data portion, the indicating data being indicative of the component identity;

(b) generates, from the received indicating data, component identity data indicative of the
identity of the component; and,

(c) assembles the object using the component identity data.

40) The system of claim 39, wherein assembly system includes:

(a) an input for receiving the indicating data;

(b) one or more manipulators for manipulating the component; and,

(c) a controller for controlling the manipulators, to thereby pack the component.

41) The system of claim 39, wherein the assembly system is adapted to perform the method of
claim 13.

42) A system for assembling an object using a component, the component having an interface
surface having coded data disposed thereon or therein, wherein the coded data includes a
plurality of coded data portions, each coded data portion being indicative of an identity of the

component and the position of the coded data portion on the interface surface, wherein the system includes a computer system which:

- (a) receives, from a sensing device, indicating data generated in response to sensing of a coded data portion, the indicating data being indicative of the component identity;
- (b) generates, from the received indicating data, component identity data indicative of the identity of the component; and,
- (c) causes, using the component identity data, an assembly system to assemble the object.

43) The system of claim 42, wherein the computer system is adapted to perform the method of claim 22.

44) The system of any one of claims 35, 39 and 42, wherein the assembly system includes a computer system.

45) The system of any one of claims 35, 39 and 42, wherein the assembly system communicates with a remote computer system.

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